PENDING CLAIMS

1. A commercial jetplane capable of flying at a cruise speed of Mach=0.78 or above, comprising:

a fuselage;

a landing gear mounted on said fuselage;

a single wing attached to said fuselage, said single wing being substantially unswept with a high aspect ratio, and including:

a forward airfoil element having an upper surface and a lower surface;

an aft airfoil element having an upper surface and a lower surface;

an internal structure comprising at least two spars extending from one tip to an opposing tip of said single wing, with a rear one of the spars being straight and unswept in plan view;

an airfoil structure having a slot that allows airflow from the forward airfoil element to the aft airfoil element, wherein during cruising flight of the airplane, said airfoil structure having said slot diverts some of the air flowing along the lower surface of the forward airfoil element to flow over the upper surface of the aft airfoil element, and where the lower surface of the forward airfoil element and the lower surface of the aft airfoil element are shaped to provide an efficient cross section for a main structural box of the single wing; and

said wing and said fuselage being constructed of at least one of aluminum and graphite composite.

2. The airplane of claim 1 wherein said airfoil structure having a slot produces natural laminar flow over the aft airfoil element of said single wing.

3. The airplane of claim 1 wherein said airfoil structure having said slot produces natural laminar flow over the forward airfoil element of said single wing.

4. The airplane of claim 1 wherein heat is transferred from a leading edge of at least one of said wing and main flap to increase the extent of said natural laminar flow.

5. An airplane of claim 1 which comprises a "T"-tail type empennage.

6. The airplane of claim 1 which comprises a "V"-tail type empennage.

7. The airplane of claim 1 which comprises a low tail type empennage.

8. The airplane of claim 7, wherein at least two high bypass ratio engines are attached to the airframe.

9. The airplane of claim 8 wherein said high bypass engines are geared fan engines or unducted fans which are energy efficient with reduced fuel consumption, noise and greenhouse gas emissions.

10. The airplane of claim 1 wherein the reduced rotation angle also decreases the aft body upsweep and reduces drag.

11. An airplane of claim 1 wherein said single wing is attached to the top of said fuselage and the engines are attached below the wing.

12. An airplane of claim 1 wherein said single wing is attached to the bottom of said fuselage and said engines are attached to the aft end of the fuselage.

<u>13. An aircraft, comprising:</u>

<u>a fuselage,</u>

at least one wing attached to the fuselage, the wing having an upper surface, a lower surface, and an internal structure including at least one spar;

a trailing edge device carried by the wing, the trailing edge device having an upper surface and a lower surface, the upper surface of the trailing edge device being recessed away from an aft-extended contour of the wing upper surface in a thickness direction along its entire length when in a neutral, undeflected, undeployed position, at least one of the at least one wing and the trailing edge device having a spanwise slot that allows airflow from the at least one wing to the trailing edge device, the slot having an aft-facing exit opening at an offset between the upper surfaces of the at least one wing and the trailing edge device, the offset being in the thickness direction, wherein during cruising flight of the aircraft, the slot diverts some of the air flowing along the lower surface of the at least one wing through the slot to flow over the upper surface of the trailing edge device, the lower surface of the at least one wing and the lower surface of the trailing edge device being shaped to provide an efficient cross section for a main structural box of the at least one wing; and

landing gear depending from the fuselage.

14. The aircraft of claim 13 wherein the at least one wing is at least approximately unswept.

15. The aircraft of claim 13 wherein the slot is configured to remain open at all flight conditions.

16. The aircraft of claim 13 wherein the at least one wing is configured to operate at a cruise Mach number of 0.78 or higher.

17. The aircraft of claim 13 wherein the at least one spar includes a forward spar and an aft spar forming portions of opposing sides of a wing box.

18. The aircraft of claim 13 wherein the at least one wing includes a forward spar and an aft spar and wherein at least one of the forward and aft spars is at least approximately unswept.

19. The aircraft of claim 13 wherein the at least one spar extends in an at least generally straight line from one side of the fuselage to the other.

20. The aircraft of claim 13 wherein the at least one wing includes a single wing having a common structure extending from a first side of the fuselage to a second side of the fuselage.

21. The aircraft of claim 13 wherein the at least one wing includes a single wing having a unitary structure extending from a first side of the fuselage to a second side of the fuselage.

22. The aircraft of claim 13 wherein the at least one wing includes a structure extending from a first side of the fuselage to a second side of the fuselage without a splice.

23. The aircraft of claim 13 wherein the slot extends over less than an entire span of the at least one wing.

24. The aircraft of claim 13 wherein the wing includes an aileron, and wherein the slot extends spanwise through a region of the at least one wing containing the aileron.

25. The aircraft of claim 13 wherein the at least one wing includes a single wing extending from a first tip on a first side of the fuselage to a second tip on a second side of the fuselage, and wherein the at least one wing further includes forward and aft spars, the forward spar extending from a first position at least proximate to the first tip to a second position at least proximate to the second tip, the aft spar extending from a third position at least proximate to the first tip to a fourth position at least proximate to the second tip.

26. The aircraft of claim 13 wherein the slot is a first slot, and wherein the trailing edge device is movable relative to the at least one wing to form a second slot forward of the first slot and divert additional air from the lower surface of the wing to the upper surface of the trailing edge device.

27. The aircraft of claim 13 wherein at least one of the upper surface and lower surface of at least one of the wing and the trailing edge device includes a composite material.

28. The aircraft of claim 13, further comprising a propulsion system depending from at least one of the at least one wing and the fuselage.

29. The aircraft of claim 13, further comprising an empennage aft of the at least one wing.

30. The aircraft of claim 13 wherein the slot is configured to divert air sufficient to increase a critical Mach number of the aircraft.

31. The aircraft of claim 13 wherein the slot is configured to divert air sufficient to increase a maximum cruise speed of the aircraft.

32. An aircraft, comprising:

a fuselage,

at least one wing attached to the fuselage, the at least one wing including:

a forward airfoil element having an upper surface and a lower surface;

at least one spar positioned within the forward airfoil element and extending in an at least generally straight line from one side of the fuselage to the other;

an aft airfoil element having an upper surface and a lower surface, the aft airfoil element being coupled to the forward airfoil element, the aft airfoil element having a leading edge spaced apart from a portion of the forward airfoil element with a slot positioned between the portion of the forward airfoil element and the leading edge of the aft airfoil element, the slot being configured to be open during cruise flight to divert some of the air flowing along the lower surface of the forward airfoil element to flow over the upper surface of the aft airfoil element;

a propulsion system depending from at least one of the at least one wing and the fuselage; and

landing gear depending from the fuselage.

33. The aircraft of claim 32 wherein the at least one wing is configured for a subsonic cruise speed of at least Mach 0.78.

34. The aircraft of claim 32 wherein the at least one wing has an at least approximately unswept leading edge.

35. The aircraft of claim 32 wherein the at least one spar is at least approximately unswept.

36. The aircraft of claim 32 wherein the slot is configured to divert air sufficient to increase a critical Mach number of the aircraft.

37. The aircraft of claim 32 wherein the slot is configured to divert air sufficient to increase a maximum cruise speed of the aircraft.

38. (Canceled)

39. The aircraft of claim 32 wherein the at least one wing includes a single wing having a unitary structure extending from a first side of the fuselage to a second side of the fuselage.

40. The aircraft of claim 32 wherein the slot extends over less than an entire span of the at least one wing.

41. The aircraft of claim 32 wherein the at least one wing includes an aileron, and wherein the slot extends spanwise through a region of the at least one wing containing the aileron.

42. An aircraft system, comprising:

at least one wing having an upper surface shaped to include at least one transonic region during cruise flight; and

a flap assembly that includes a forward airfoil element having an upper surface portion and a lower surface portion, and an aft airfoil element coupled to the forward airfoil element, the aft airfoil element having an upper surface portion and a lower surface portion, at least a part of the aft airfoil element being spaced apart from a part of the forward airfoil element by a fixed first slot, the first slot being configured to be open during cruise flight to divert some of the air flowing along the lower surface portion of the wing to flow

over the upper surface portion of the aft airfoil element, the first slot having an aft-facing exit opening at an offset between the upper surface of the wing and the upper surface portion of the aft airfoil element, the offset being in the thickness direction, and wherein the forward airfoil element and the aft airfoil element are movable as a unit relative to the at least one wing to open a second slot between the forward airfoil element and the at least one wing, the forward and aft airfoil elements having a fixed angular relationship with each other when the second slot is open and when the second slot is closed.

43. The aircraft system of claim 42 wherein the at least one wing is shaped to be efficient at a transonic condition.

44. The aircraft system of claim 42, further comprising:

a fuselage coupled to the at least one wing,

a propulsion system depending from at least one of the at least one wing and the fuselage; and

landing gear depending from at least one of the at least one wing and the fuselage.

45. The aircraft system of claim 42 wherein the at least one wing is at least approximately unswept.

46. The aircraft system of claim 42 wherein the at least one wing overlaps the trailing edge assembly by three percent of a combined chord length of the at least one wing and the flap assembly when the flap assembly is stowed.

47. The aircraft system of claim 42 wherein the slot extends over less than an entire span of the at least one wing.

48. The aircraft system of claim 42 wherein the at least one wing includes an aileron, and wherein the slot extends spanwise through a region of the at least one wing containing the aileron.

49. (Canceled)

50. The aircraft system of claim 42 wherein the slot is configured to divert air sufficient to increase a critical Mach number of the aircraft.

51. The aircraft system of claim 42 wherein the slot is configured to divert air sufficient to increase a maximum cruise speed of the aircraft.

52. An aircraft system, comprising:

at least one wing having a leading edge, an upper surface, and a lower surface, the upper surface being shaped to include at least one transonic region during cruise flight; and

a trailing edge device carried by the at least one wing, the trailing edge device having an upper surface and a lower surface, the upper surface of the trailing edge device being recessed away from an aft-extended contour of the at least one wing upper surface in a thickness direction along its entire length when in a neutral, undeflected position, at least one of the at least one wing and the trailing edge device having a spanwise slot, the slot having an aft-facing exit opening at an offset between the upper surfaces of the at least one wing and the trailing edge device, the offset being in the thickness direction, the slot being configured to be open during cruise flight to divert some of the air flowing along the lower surface of the at least one wing to flow over the upper surface of the trailing edge device, the slot being positioned to increase a Mach number at which the at least one wing undergoes transonic drag rise by about 0.03 compared with a

wing having generally similar shape without the slot, the Mach number corresponding to a component of flow travelling generally normal to the leading edge of the at least one wing.

53. The aircraft system of claim 52, further comprising:

a fuselage coupled to the at least one wing;

a propulsion system depending from at least one of the at least one wing and the fuselage; and

landing gear depending from at least one of the at least one wing and the fuselage.

54. The aircraft system of claim 52 wherein the at least one wing is shaped to be efficient at a transonic condition.

55. The aircraft system of claim 52 wherein the at least one wing is at least approximately unswept.

56. The aircraft system of claim 52 wherein the slot is configured to remain open at all flight conditions.

57. The aircraft system of claim 52 wherein the at least one wing includes at least one spar that is at least approximately unswept.

58. The aircraft system of claim 52 wherein the slot extends over less than an entire span of the at least one wing.

59. The aircraft system of claim 52 wherein the at least one wing includes an aileron, and wherein the slot extends spanwise through a region of the at least one wing containing the aileron.

60. The aircraft system of claim 52 wherein the slot is a first slot and wherein the trailing edge device includes a forward portion and an aft portion, the forward portion and the aft portion being movable as a unit relative to the at least one wing to form a second slot forward of the first slot and divert additional air from the lower surface of the at least one wing to the upper surface of the trailing edge device.

61. The aircraft system of claim 52 wherein the at least one wing overlaps the trailing edge device by a distance at least approximately equal to three percent of a combined chord length of the at least one wing and the trailing edge device.

62. An aircraft system, comprising:

at least one wing, the at least one wing having an upper surface and a lower surface;

an internal structure including at least one spar; and

an airfoil structure including a trailing edge device carried by the at least one wing, the trailing edge device having an upper surface and a lower surface, the upper surface of the trailing edge device being recessed away from an aft-extended contour of the at least one wing upper surface in a thickness direction along its entire length when in a neutral, undeflected, undeployed position, at least one of the at least one wing and the trailing edge device having a spanwise slot that allows airflow from the at least one wing to the trailing edge device, wherein during cruising flight of the at least one wing, the airfoil structure diverts some of the air flowing along the lower surface of the at least one wing through the slot to flow over the upper surface of the trailing edge device.

63. The aircraft system of claim 62 wherein the slot extends over less than an entire span of the at least one wing.

64. The aircraft system of claim 62 wherein the at least one wing includes an aileron, and wherein the slot extends spanwise through a region of the at least one wing containing the aileron.

65. A method for manufacturing an aircraft system, comprising coupling a trailing edge device to an aircraft wing, with the aircraft wing overlapping the trailing edge device by a distance at least approximately equal to three percent of a combined chord length of the aircraft wing and the trailing edge device, and with a spanwise slot positioned between at least part of the aircraft wing and at least part of the trailing edge device, the slot being configured to be open during cruise flight to divert some of the air flowing along a lower surface of the aircraft wing to flow over an upper surface of the trailing edge device, the upper surface of the trailing edge device being recessed away from an aft-extended contour of the aircraft wing upper surface in a thickness direction along its entire length when in a neutral, undeflected, undeployed position, the slot having an aft-facing exit opening at an offset between an upper surface of the aircraft wing and the upper surface of the trailing edge device, the offset being in the thickness direction.

66. The method of claim 65, further comprising:

attaching the aircraft wing to a fuselage;

connecting a propulsion system to at least one of the aircraft wing and the fuselage; and

coupling landing gear to at least one of the aircraft wing and the fuselage.

67. The method of claim 65 wherein coupling a trailing edge device to an aircraft wing includes coupling the trailing edge device to an at least approximately unswept aircraft wing.

68. The method of claim 65, further comprising configuring the slot to remain open at all flight conditions.

69. The method of claim 65, further comprising supporting the aircraft wing with at least one spar that is at least approximately unswept.

70. The method of claim 65, further comprising positioning the slot to extend over less than an entire span of the aircraft wing.

71. The method of claim 65, further comprising attaching an aileron to the aircraft wing and positioning the slot to extend spanwise through a region of the aircraft wing containing the aileron.

72. A method for manufacturing an aircraft system, comprising:

coupling a trailing edge device to an aircraft wing; and

positioning a slot between at least part of the aircraft wing and at least part of the trailing edge device to increase a Mach number at which the aircraft wing undergoes transonic drag rise by about 0.03 compared with an aircraft wing having a generally similar shape without the slot, the Mach number corresponding to a component of flow travelling generally normal to the leading edge of the aircraft wing, the slot being configured to be open during cruise flight to divert some of the air flowing along a lower surface of the aircraft wing to flow over an upper surface of the trailing edge device.

73. The method of claim 72, further comprising:

attaching the aircraft wing to a fuselage;

connecting a propulsion system to at least one of the aircraft wing and the fuselage; and

coupling landing gear to at least one of the aircraft wing and the fuselage.

74. The method of claim 72 wherein coupling a trailing edge device to an aircraft wing includes coupling a trailing edge device to an at least approximately unswept wing.

75. The method of claim 72, further comprising configuring the slot to remain open at all flight conditions.

76. The method of claim 72, further comprising supporting the aircraft wing with at least one spar that is at least approximately unswept.

77. The method of claim 72, further comprising positioning the slot to extend over less than an entire span of the aircraft wing.

78. The method of claim 72, further comprising attaching ailerons to the wing and positioning the slot to extend spanwise through a region of the wing containing the ailerons.